

motive force of 30 or even 40 volts between the carbons in the electric arc, but that the actual resistance of the arc is small.

4. The electro-dynamometer method, the best method fitted for ready measurement, in which the current in one coil is attracted by the same current flowing in another coil, and the attraction is balanced by a spring as in Siemens's electro-dynamometer, or by weights as in Trowbridge's electro-dynamometer. A beautifully-made instrument by Elliott and Co. was exhibited, in which the coils are thick copper bands, fixed coils being placed on each side like the coils of a tangent galvanometer, the suspended coil being placed between them in place of the magnet of the galvanometer. This instrument is especially useful for the measurement of very large currents in absolute measure.

The remainder of the second lecture was devoted to the consideration of the efficiency of batteries or of magneto-electric machines when employed as motors to do work by means of electricity, and it was shown that the greatest amount of effective work is produced when one-half the energy of the battery or current-generating machine is converted into useful work in the electric circuit. Numerous experiments were made with Clarke's and other magneto-electric machines to show that by the same machine work may be produced by sending a battery current through it, causing motion of the armature carrying the current in accordance with Ampère's laws, or a current of electricity may be generated by turning the armature, *i.e.* by doing work upon the machine, so that a magneto-machine is a reversible engine. A small magneto-machine with a Siemens armature was made to work a pump, or when turned by hand produced a current of electricity. Also a battery current in a Gramme ring in front of the poles of a Jamin magnet caused rotation of the ring and turned the heavy driving-wheel of the machine, and on removing the battery and turning the driving-wheel by hand, a current of electricity was produced which caused a piece of platinum wire to glow. Also a Tisley's hand dynamo-machine was employed either to heat a long piece of platinum wire or to drive another magneto-electric machine, so producing a secondary current capable of heating a considerable length of platinum wire.

(To be continued.)

THE FRENCH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE AT ALGIERS

Algiers, April 14

THE number of members enrolled for the present Congress is much larger than might have been expected when we consider the length of the journey. To a Parisian member this is such as would be experienced by a Londoner if our British Association met in Gibraltar. Yet more than 1500 names are on the list. Few of these are familiar to us. There appear to be an unusual number of doctors and professors of anatomy and physiology, and of civil engineers. We fear we must also confess that a great many people possessing little or no interest in science, who will not be present at a single sectional meeting, have joined the Association for the sake of seeing Algiers. The general character of the meeting appears to be that of a great excursion. There are only five days partially devoted to work; while the banquets, balls, fêtes, courses, and "fantasias" are rapidly multiplying.

On arriving in Paris we were told that the steamer which was to have conveyed us to Algiers had been requisitioned by the Government for the transport of troops to Tunis; but the Company determined at last to take both soldiers and savants, and the result was of course an overcrowded boat and excessive discomfort. With accommodation for fifty first-class passengers no less than

one hundred and twenty-nine were crowded into the vessel, and had the voyage been anything but of the smoothest, it would have been most wretched. As it was it was bad enough; the food was insufficient in quantity and detestable in quality, and passengers were glad to find six feet of floor to sleep upon. In Algiers itself the hotels are quite full, and the salons will be used as dormitories.

The Congress will be opened to-day by the inaugural address of M. Chauveau, which is to be given in the theatre at three o'clock, after which the members will remain and resolve themselves into a general committee to discuss the creation of a sixteenth section relating to pedagogy; afterwards the secretaries of sections will meet to arrange their proceedings, and at 9 p.m. the members will be received by the Municipality at the Hotel de Ville. The general programme for the rest of the week is as follows:—

Friday, April 15.—Sectional meetings in the forenoon; general meeting at 2 p.m.; conference at half-past 8.

Saturday.—Sectional meetings in the morning; visit to the Algerian Exhibition in the afternoon; Arab *fête*, and a *souirée* given by the Municipality.

Sunday.—“Courses et fantasia.”

Monday.—Sectional meetings in the morning; a procession through the town in the afternoon, and an Arab *fête* in the evening.

Tuesday.—Sectional meetings; general concluding meeting; in the evening a ball given by the Governor.

On *Wednesday* the excursions commence; they are both general and sectional, and the longest lasts for a fortnight.

A complete list of the papers to be read has not yet appeared, but in the list already published we do not note anything of special interest.

English science is represented by Dr. G. H. Gladstone and Mr. Siemens, who will both read papers.

The Association has presented to each member a work in two volumes entitled “*Notices scientifiques, historiques, et économiques sur l'Algier et l'Algérie.*”

April 15

The theatre was well filled yesterday afternoon to hear the address of the president, M. Chauveau, who is Professor of Physiology in the Lyons Veterinary College. His discourse was of a far too technical character to be of interest to the majority of his audience, and dealt principally with the germ theory and Pasteur's theory of fermentation. It was read throughout without the least attempt at oratory, and it contained various political allusions which were much applauded. In the evening the members were entertained by the Municipality, and the town was illuminated. The real work of the Association commenced this morning, when the sections met at hours varying from eight to ten o'clock. We fear that the number of papers is small, and that the Association does not represent French science at all completely. In the Physical Section, for example, the names of only two authors of papers appear to-day—MM. Brillouin and Crova. At 9 a.m., when the section was announced to meet, no one was present. Shortly afterwards the secretary arrived, but an hour later the section had not met. The average number of the audience at the sections which had already met did not at this time exceed ten.

Among the more interesting papers announced for to-day are the following:—M. Marcheray, on Telephonic Communication in large towns; M. Tacchini, on the Observatories of Etna and of Chimona; M. Thoulet, on the Employment of the Microscope in Chemical and Physical Researches connected with Mineralogy; M. Prungueber, on 300 Anthropological Observations on the Kabyles of the Djurdjura Mountains.

The Medical and Agronomical Sections have plenty of communications. The new section of Pedagogy has been established under the honorary presidency of M.

Godard, Director of the École Monge in Paris, who has brought twenty of the pupils with him. M. Fau, Attorney-General of Algiers, is the President, and two papers are announced for to-day:—One by M. Robert, on the Humanitarian and Pedagogic Ideas of Jean Comimiac (1572-1670); the other by M. Berdellé, on the Employment of Colours as a Means of Retaining in the Mind certain given Numbers.

An excellent geological map of Algiers to the scale of 1 in 800,000 has recently been completed, and the formation of it has led to the simultaneous observation of various facts connected with the physical geography of the Central Sahara. A map of the proposed interior sea of the Sahara has also been prepared, and the Trans-Sahara Railway is spoken of as more than a probability. But we very much doubt if this can ever be a success. If it connected flourishing towns or portions of territory in which great cities are ever likely to be established, as in the case of the new American railways, there would be some hope for it. As it is, however over-populated the world may become, there is no likelihood of the formation of settlements in the heart of an unhealthy tropical region.

G. F. RODWELL

MR. DARWIN ON VIVISECTION

FROM the *Times* we reproduce the following letter addressed by Mr. Darwin to Prof. Holmgren of Upsala, in answer to a request for an expression of his opinion on the question of the right to make experiments on living animals for scientific purposes—a question which is now being much discussed in Sweden:—

"Down, Beckenham, April 14, 1881

"Dear Sir,—In answer to your courteous letter of April 7 I have no objection to express my opinion with respect to the right of experimenting on living animals. I use this latter expression as more correct and comprehensive than that of vivisection. You are at liberty to make any use of this letter which you may think fit, but if published I should wish the whole to appear. I have all my life been a strong advocate for humanity to animals, and have done what I could in my writings to enforce this duty. Several years ago, when the agitation against physiologists commenced in England, it was asserted that inhumanity was here practised and useless suffering caused to animals; and I was led to think that it might be advisable to have an Act of Parliament on the subject. I then took an active part in trying to get a Bill passed, such as would have removed all just cause of complaint, and at the same time have left physiologists free to pursue their researches—a Bill very different from the Act which has since been passed. It is right to add that the investigation of the matter by a Royal Commission proved that the accusations made against our English physiologists were false. From all that I have heard however I fear that in some parts of Europe little regard is paid to the sufferings of animals, and if this be the case I should be glad to hear of legislation against inhumanity in any such country. On the other hand I know that physiology cannot possibly progress except by means of experiments on living animals, and I feel the deepest conviction that he who retarded the progress of physiology commits a crime against mankind. Any one who remembers, as I can, the state of this science half a century ago must admit that it has made immense progress, and it is now progressing at an ever-increasing rate.

"What improvements in medical practice may be directly attributed to physiological research is a question which can be properly discussed only by those physiologists and medical practitioners who have studied the history of their subjects; but, as far as I can learn, the benefits are already great. However this may be, no one,

unless he is grossly ignorant of what science has done for mankind, can entertain any doubt of the incalculable benefits which will hereafter be derived from physiology, not only by man, but by the lower animals. Look, for instance, at Pasteur's results in modifying the germs of the most malignant diseases, from which, as it so happens, animals will in the first place receive more relief than man. Let it be remembered how many lives and what a fearful amount of suffering have been saved by the knowledge gained of parasitic worms through the experiments of Virchow and others on living animals. In the future every one will be astonished at the ingratititude shown, at least in England, to these benefactors of mankind. As for myself, permit me to assure you that I honour, and shall always honour, every one who advances the noble science of physiology.

"Dear sir, yours faithfully,

"CHARLES DARWIN

"To Prof. Holmgren"

THE MAGNETIC SURVEY OF MISSOURI

IN the summer of 1878 the writer began a magnetic survey of the State of Missouri. The work of the first summer was confined to the north-east part of the State, and no points of interest were brought out. During the summer of 1879 the work was extended over the western half of the State, and it was made apparent that diversity of surface exerted a much more important influence than had been suspected. The lines of equal declination were found to bend very sharply upon entering the large valleys, and the needle showed a *tendency* to set at right angles to the valleys. This tendency seemed to be greatest when the general direction of the valley made an angle of 45° with the *normal* position of the needle, or roughly, when the valley runs north-east and south-west, or north-west and south-east. This tendency seems to be inappreciable when the valleys run north and south, or east and west.

In the report of 1878 (*Trans. St. Louis Acad. of Sc.*, vol. iv. No. 1, p. 143) it was suggested that this might result from the bending of the stream-lines of the earth-current sheet, due to the greater conducting power of the moist valleys. In order to settle this point, further examination is necessary, and it is proposed to determine the earth-currents at a number of properly selected stations.

During the summer of 1880 the work extended over the south-eastern part of the State, where still more important flexures of the isogonic lines were discovered. Here, however, the position of the needle is probably affected by the iron deposits, and the effect of contour is studied to less advantage. At the close of 1880 observations had been made at forty-five stations. In order to bring out the effect of contour, a relief map of the State was constructed in wax, and was finally reproduced in plaster. In this work use was made of the profiles of all the railroads in the State, together with a list of over 300 elevations in the State, collected by Gannett. The isogonic lines, which were first drawn upon an ordinary map, in the usual manner, to represent the observations thus far made, were then copied upon the relief map. In doing this it became apparent at once that the forty-five stations were wholly inadequate, and that the isogonic lines thus drawn are probably deserving of about the same weight that a topographical map would deserve if constructed from elevations at these stations.

The Chart is made after an artotype, which will accompany the third annual report in No. 2, vol. iv. *Trans. St. Louis Academy of Science*. In the original map the horizontal scale is twenty miles to the inch, the elevations being exaggerated 200 times. This exaggeration was necessary in order to bring out the form in the photograph, since on a relief map, 150 feet square, the